REMARKS

Claims 1-5, 8-17, 28, and 30-32 are pending in the present application. Applicants are pleased to note that Claims 6 and 7 have been allowed.

Claim Rejections Under 35 U.S.C. § 103

Claims 1, 3-5, 8-17, 28, and 30-32 were rejected under 35 U.S.C. § 103 as obvious over the combination of Sundararajan et al. (U.S. Patent Application No. 2002/0027286) and Donnelly, Jr. et al. (U.S. Patent No. 6,143,658). Claims 2 and 31 were rejected over this combination further in view of what the Examiner characterizes as admitted prior art.

In the rejection, the Examiner found that Sundararajan et al. discloses a process for producing an integrated circuit comprising forming a damascene structure on a substrate, forming a copper oxide on the copper during CMP and reducing copper oxide by contact with hydrogen or ammonia plasma. Sundararajan et al. does not teach reducing copper oxide with an organic, vapor-phase reducing agent that is not plasma activated. The Examiner maintains that this deficiency is made up for by Donnelly, Jr. et al. which teaches vapor phase reduction of copper oxide using an organic reducing agent, specifically H(hfac) or hexafluoroacetylacetone.

Applicants previously argued that Donnelly, Jr. et al. does not teach the *reduction* of copper oxide with a vapor phase organic *reducing agent* and that the teachings are limited to *etching* of copper oxide with H(hfac). In response to this argument, the Examiner states that there is nothing in Applicants' definition of reduction, as provided in the specification, that prohibits removal of copper along with the oxygen. The Examiner concludes that Donnelly, Jr. meets Applicants own definition of reduction because oxygen is being removed from the copper layer. The Examiner also found that it is improper for Applicant to put forth an argument that directly contradicts Applicants own definition.

Applicants respectfully submit that the argument that Donnelly, Jr. teaches etching and does not teach reduction of a copper oxide layer *does not* contradict Applicants' definition of reduction as provided in the specification. Applicants' definition states that "as used herein, the terms 'reduction' and 'reducing' refer to the removal of oxygen atoms from a copper layer. 'Reduction' does not have to be complete reduction, and some oxygen atoms may remain in a copper layer after it has been reduced. Thus, a copper layer that is 'reduced' or 'at least partially reduced' is a copper layer from which some, but not necessarily all oxygen atoms have been

removed." While the Examiner is correct that there is nothing in the definition that explicitly prohibits removal of copper along with the oxygen, there is also nothing that indicates etching is equivalent to reducing. Thus, it is not contradictory to argue that etching of copper oxide is inconsistent with this definition.

As the Examiner points out repeatedly, the definition needs to be interpreted in view of the ordinary and customary meaning of this term. One of skill in the art will recognize that the terms "reducing" and "reduction" refer to the removal of oxygen atoms from a material, rather than the removal of the entire material including the oxygen atoms. That is, the term reducing as used in the present application refers to *chemical reduction* and not simply to the diminishment of the copper oxide layer. Applicants have attached a copy of the definition of reduce from the American Heritage Dictionary of the English Language, Fourth Edition (2000). The definition of "reduce" as used in chemistry is "a. to decrease the valence of (an atom) by adding electrons; b. to remove oxygen from (a compound); c. To add hydrogen (to a compound); and d. to change to a metallic state by removing non-metallic constituents." Definition 6(b) is applicant's definition.

One of skill in the art will immediately recognize that Applicants are referring to chemical reduction, in view of both the exact correspondence between Applicant's definition and the dictionary definition and in view of the disclosure in the specification. For example, the specification teaches the "at least partial reduction of copper oxide *to copper*" (page 8, lines 11-12, emphasis added). This makes it clear that the oxygen is being removed and copper is being left behind (chemical reduction), and that copper and oxygen are not being removed together. This is further clarified by the statement that the "CuO layer is reduced by exposure to an organic reducing agent that is capable of removing oxygen from the metal oxide, *leaving elemental copper on the substrate*" (page 8, lines 22-24, emphasis added). Further, the heading on page 13a refers to "Alternative Reduction Chemistries," indicating that the appropriate definition of reduction is the one that is specific for chemistry. Finally, the specification teaches that when the copper oxide layer is reduced, the reducing agent is oxidized (page 9, lines 5-6 and page 10, lines 16-17). One of skill in the art will recognize that chemical reduction is accompanied by oxidation of the reducing agent. A simple explanation of this basic principle is provided in the attached excerpt from the Encyclopedia Brittanica Online.

Thus, one of ordinary skill in the art would that Applicants' definition of reduction does not contradict the ordinary and customary meaning of the term and simply clarifies that the

reduction does not have to be a complete reduction and that some oxygen atoms may remain in the copper layer after it has been reduced.

As Donnelly, Jr. et al. teaches etching and thus the removal of a copper oxide layer, it does not teach the chemical reduction of copper oxide and does not make up for the deficiencies of Sundararajan et al. As a result, Applicants request the withdrawal of the rejections under 35 U.S.C. § 103.

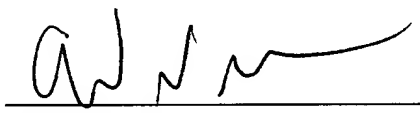
CONCLUSION

Applicants submit that the present application is in condition for allowance and respectfully requests the same. If any issues remain, the Examiner is cordially invited to contact Applicants' representative at the number provided below in order to resolve such issues promptly.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: June 30, 2004

By: 

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The American Heritage® Dictionary of the English Language: Fourth Edition. 2000.

reduce

SYLLABICATION: re·duce

PRONUNCIATION: rĭ-do͞os′, -dyo͞os′

VERB: Inflected forms: **re·duced, re·duc·ing, re·duc·es**

TRANSITIVE VERB: **1.** To bring down, as in extent, amount, or degree; diminish. See synonyms at **decrease**. **2.** To bring to a humbler, weaker, difficult, or forced state or condition; especially: **a.** To gain control of; conquer: *"a design to reduce them under absolute despotism"* (Declaration of Independence). **b.** To subject to destruction: *Enemy bombers reduced the city to rubble.* **c.** To weaken bodily: *was reduced almost to emaciation.* **d.** To sap the spirit or mental energy of. **e.** To compel to desperate acts: *The Depression reduced many to begging on street corners.* **f.** To lower in rank or grade. See synonyms at **demote**. **g.** To powder or pulverize. **h.** To thin (paint) with a solvent. **3.** To lower the price of: *The store has drastically reduced winter coats.* **4.** To put in order or arrange systematically. **5.** To separate into orderly components by analysis. **6.** *Chemistry* **a.** To decrease the valence of (an atom) by adding electrons. **b.** To remove oxygen from (a compound). **c.** To add hydrogen to (a compound). **d.** To change to a metallic state by removing nonmetallic constituents; smelt. **7.** *Mathematics* To simplify the form of (an expression, such as a fraction) without changing the value. **8.** *Medicine* To restore (a fractured or displaced body part) to a normal condition or position.

INTRANSITIVE VERB: **1.** To become diminished. **2.** To lose weight, as by dieting. **3.** *Biology* To undergo meiosis.

ETYMOLOGY: Middle English *reducen*, to bring back, from Old French *reducier*, from

Latin *redūcere* : *re-*, re- + *dūcere*, to lead; see **deuk-** in Appendix I.

OTHER FORMS:
re·duc'er —NOUN
re·duc'i·bil'i·ty —NOUN
re·duc'i·ble —ADJECTIVE
re·duc'i·bly —ADVERB

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〈 redtop reducing agent 〉

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oxidation-reduction

Britannica Concise

or redox

Any chemical reaction in which electrons are transferred.

Addition of hydrogen or electrons is reduction, and removal of hydrogen or electrons is oxidation (originally applied to combination with oxygen but now including transfer of hydrogen or electrons). The processes always occur simultaneously: one substance is oxidized by the other, which it reduces. The conditions of the substances before and after are called oxidation states, to which numbers are given and with which calculations can be made. (Valence is a similar but not identical concept.) The chemical equation that describes the electron transfer can be written as two separate half reactions that can in theory be carried out in separate compartments of an electrolytic cell (*see* electrolysis), with electrons flowing through a wire connecting the two. Strong oxidizing agents include fluorine, ozone, and oxygen itself; strong reducing agents include alkali metals such as sodium and lithium.